REMARKS

Claims 15 and 17-21 are pending in this application. No amendment is made in this Response. It is believed that this Response is fully responsive to the Office Action dated **February 13, 2008**.

Claims 15 and 17-20 are rejected under 35 U.S.C. §103(a) as being unpatentable over Muramatsu (U.S. Patent Application Publication 2002/0002112) in view of Hashimoto et al. (USPN 5,955,198) and Akui et al. (U.S. Patent Application Publication 2002/0042343). (Office action paragraph no. 3)

The rejection of claims 15 and 17-20 is respectfully traversed, and reconsideration is requested.

The Examiner cites Muramatsu for disclosing a photoelectrode for dye-sensitized solar cells comprising a porous titanium oxide film, citing [0008] and [0038], formed on an electrically conductive transparent layer, citing paragraph [0039].

Hashimoto et al. is cited for disclosing a base plate 1 over which an electrically conductive transparent layer 3 is formed, where the base plate may be formed of glass or a transparent high polymer, citing column 1, lines 20-27. Akui is cited for teaching forming a porous titanium oxide film over a transparent substrate (paragraph [0048]). The Examiner states that it would have been obvious to "use a high polymer for the base plate because they are art-recognized equivalents ...."

In traversing the rejection, Applicant generally argues that: 1) None of the cited references suggests the limitation of drying temperature of 130 to 180 °C recited in base claim 15; 2) The Hashimoto et al. reference cannot be combined with Muramatsu and Akui et al.; and 3) There are unexpected results commensurate in scope with the present claims.

1) With regard to the limitation on the temperature of drying the coating, Applicant argued in the Amendment dated June 27, 2007, on page 10, that Akui discloses calcining at a temperature of not lower than 200 °C, and therefore does not suggest the limitation of claim 15. However, the Examiner states (page 4 of Office action, at bottom) that Akui does discloses a temperature "of about 200 °C or lower" in paragraph [0049]. Applicant respectfully submits that the Examiner appears to be incorrect in this regard. Paragraph [0049] clearly states twice that the temperature is "**not** lower than 200 °C" (emphasis added), and states specific reasons why the temperature should be "200 to 700 °C." There is **no overlap** between this range and the range of 130 to 180 °C in claim 15.

Similarly to Akui et al., the coating compositions used in Muramatsu comprise an aqueous peroxotitanic acid solution or titanium oxide precursor sol solution, together with polyethylene glycol. Thus, unless the applied composition is heated at a temperature of 200°C or higher, the polyethylene glycol does not evaporate, thus, failing to obtain a favorable porous film (Muramatsu, paragraphs [0085] and [0087]). Accordingly, in Muramatsu, the substrate is substantially limited to glass, and it is impossible to form a porous titanium oxide film on a thermoplastic substrate, such as a high polymer film or the like.

2) Thermoplastic resin substrates which deform or degrade at temperatures of 200°C or higher are therefore not used in Akui et al. and Muramatsu. Accordingly, the disclosure of newly cited reference Hashimoto et al., which discloses a PET film as a substrate, **cannot be combined** with Akui et al. and Muramatsu.

3) In the Amendment of December 20, 2007, Applicant argued that there are unexpected effects associated with the limitations of claim 15, in particular associated with spraying droplets of mean diameter 1 to 25 μm. It would appear, based on the text of the Office action at the bottom of page 4, that the Examiner does not consider that Applicant has provided sufficient evidence to support the "unexpected results" argument. In particular, the Examiner comments that: "In this case, there exists no evidence of record that the mean diameter of the atomized droplets or the heating temperature provide unexpected results in the porous titanium oxide film produced." The Examiner states that the specification only requires the mean diameter of the atomized droplets to be "about 30 μm or less" and heating treatment "of about 200 °C or lower," without specific data.

Applicant respectfully disagrees. The present specification generally discusses the remarkable effects of the present invention on page 20, line 35, to page 21, line 4. The Amendment of June 27, 2007, cited Examples 1 to 3 and Comparative Example 2 of the present specification as demonstrating the effect of the droplet diameter limitation. Applicant submits that these data do support the argument that droplet sizes of less than 25 μm produce unexpected results.

Again reviewing these data, in Example 1 of the present specification, the droplet size was 19.7 μm (page 21, line 27), in Example 2 it was 24.3 μm (page 22, line 29), and in Example 3 it was

19.5 μm (page 23, line 11). In Comparative Example 2, the drop size was 41.4 μm. (See also Table 1.) The superior performance of Examples 1-3 (see Table 2, page 25), is commensurate with the drop size of less than 25 μm in the inventive Examples 1-3.

In further support of this argument, Applicant has obtained and here provides additional data in the attached Declaration under 37 CFR 1.132 by Iwao HAYASHI, signed June 18, 2008. The unexpected effects of the present invention described above are apparent from the Experiments of the attached Declaration.

The data in the Declaration further demonstrate that the effects of the present invention cannot be obtained if the atomized droplets of the dispersion liquid have a mean diameter or a heating temperature of the drying process that is out of the ranges recited in Claim 15.

Specifically, four Experiments are carried out in the attached Declaration. These Experiments should be considered supplemental to those in the Specification. As can be seen in Table 2 of page 5 of the Declaration, in Experiments 1 and 2, the mean droplet size is 0.8 and 28.9 μm, respectively, outside the range in claim 15, but the conditions are otherwise consistent with those of claim 15 (drying temperature of 150 °C is within the range in claim 15). The products of Experiments 1 and 2 have poor adhesion, attributable to the mean droplet size being outside the range of 1 to 25 μm. (See summary on page 6 of the Declaration).

Experiments 3 and 4 have drying condition temperatures of 100 and 200 °C, respectively, outside the range of 130 to 180 °C of claim 15, but are otherwise consistent with claim 15 (mean

droplet size is 19.5 μm is within the range of 1 to 25 μm.) The products of Examples 3 and 4 also have poor film formation, as explained on page 6 of the Declaration.

The results of the Experiments of the Declaration make it clear that in the process of the present invention, it is essential that the atomized droplets of the dispersion liquid of semiconductor particles discharged from the spray coater have a mean diameter of 1 to 25 μm. Also, it is essential that the heating temperature is in the range of 130 to 180 °C.

As Applicant has previously noted, the effects of the present invention are:

(i) formation of a porous film having excellent adhesion to the substrate and high strength

(ii) the dispersion liquid is unlikely to cohere to the nozzle tip and clog the nozzle

(iii) the semiconductor particles being sprayed are stabilized

(iv) the process can be carried out using a thermoplastic resin substrate as a high polymer film

(v) a porous film can be formed in which the semiconductor particles are uniformly sintered, even when the film has a large area.

Of particular note is effect (iv), that is, the process of the present invention is capable of forming a porous semiconductor film at low temperatures of 130 to 180°C and therefore can be carried out using a thermoplastic resin substrate such as a high polymer film. This effect is apparent from Example 4 of the Declaration. In contrast, in Akui et al., the applied coating composition is calcined at a temperature of **not lower than 200 °C** (Akui et al., paragraph [0038]) so that the peroxotitanic acid is converted into titanium oxide and numerous pores are produced upon

volatilization of polyethylene glycol, rendering the titanium oxide film porous (Akui et al., paragraph [0043]). This means that it is impossible to obtain a porous film at a low temperature **not higher than 200 °C**. The Examiner states that Akui et al. discloses plastic as a substrate (Akui et al., paragraph [0048]). However, Akui et al. only describes that a substrate that withstands calcination or heat treatment (i.e., at a temperature of **not lower than 200°C**) can be used. That is, in Akui et al., the substrate is **substantially limited to glass**, and it is impossible to form a porous titanium oxide film on a thermoplastic substrate, such as a high polymer film or the like. Therefore, the effect (iv) of the present invention is completely unexpected from Akui et al.

In addition, neither Akui et al., Hashimoto et al. or Muramatsu teaches or suggests the mean diameter of the atomized droplets of the coating composition during spray coating and a drying temperature of 130 to 180 °C. Therefore, the methods of Akui et al., Hashimoto et al. and Muramatsu can achieve none of the effects (i) to (v) in the production of a photoelectrode that can be accomplished by the present invention.

Applicant therefore submits that the results of the present invention are fully commensurate in scope with the limitations of claim 15, and that these results are completely unexpected over the cited references. Claims 15 and 17-20 are therefore not obvious over Muramatsu (U.S. Patent Application Publication 2002/0002112), Hashimoto et al. (USPN 5,955,198), and Akui et al. (U.S. Patent Application Publication 2002/0042343), taken separately or in combination.

Claim 21 is rejected under 35 U.S.C. §103(a) as being unpatentable over Muramatsu (U.S. Patent Application Publication 2002/0002112) in view of Hashimoto et al. (USPN 5,955,198 and Akui et al. (U.S. Patent Application Publication 2002/0042343) as applied to claims 15 and 17-20 above, and further in view of Kawazu et al. (U.S. Patent Application Publication 2002/0186469. (Office action paragraph no. 4)

The rejection of claim 21 is respectfully traversed. The Examiner cites Kawazu as disclosing coating by drying in a microwave oven. However, Applicant has argued above that base claim 15 is not obvious over the combination of Muramatsu, Hashimoto et al. and Akui et al. The disclosure of Kawazu et al. does not further provide a suggestion for 1) the heating temperature limitation, or 2) the mean droplet size limitation, of claim 15, and there is no disclosure in Kawazu that would predict the "unexpected results" of the present invention. Claim 21 is therefore not obvious over Muramatsu, Hashimoto et al., Akui et al., and Kawazu et al., taken separately or in combination.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants' undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

KRATZ, QUINTOS & HANSON, LLP

Daniel A. Geselowitz, Ph.D.
Agent for Applicants
Reg. No. 42,573

DAG/xl

Atty. Docket No. **050179**
Suite 400
1420 K Street, N.W.
Washington, D.C. 20005
(202) 659-2930

23850
PATENT & TRADEMARK OFFICE

Enclosures: Declaration under 37 CFR §1.132
Petition for Extension of Time

H:\050\050179\Response in re OA of 02-13-08